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AN
ESSAY
ON
ELECTRICITY:

Being an ENQUIRY into the
NATURE, CAUSE and PROPERTIES thereof,

On the PRINCIPLES of

Sir Isaac Newton's THEORY

OF

VIBRATING MOTION, LIGHT and FIRE;

And the various *Phænomena* of Forty-two

CAPITAL EXPERIMENTS;

With some

OBSERVATIONS relative to the USES

That may be made of this Wonderful

POWER *of* NATURE.

By BENJ. MARTIN.

We Mortals have not yet learn'd all Things of Jove; many Things hitherto remain hidden; of which some, when it shall please him, he will give us in Futurity to know.

Arat. Solenf. Phænom.

BATH,

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P R E F A C E.



HAD no Thoughts of a PREFACE to this small PAMPHLET, 'till just as the last Page was printing, I was inform'd by the Papers of a Piece of the same Kind just publish'd, by Mr. Freke, F. R. S. I immediately procured, and perused it; expecting to see the slight Pains I had taken to account for Electrical *Phænomena* quite frustrated; not that I had any Misgivings about any reasoning founded upon the irrefragable Topics of the *Newtonian* Theory, and the Suffrage of so many obvious and demonstrative *Experiments*. But when I consider'd the Force of an *Honorary Title*, and the Approbation of a Person most justly distinguished for his *superlative Understanding in all Natural Knowledge*, I began to think of the hard Fate of my Booksellers, and to say in Myself, *Actum est de me.*

BUT before I had read to two Pages, I recover'd my Spirits; and upon reading on, my great Concern for Myself and my own Book, soon began to change for the Author and his. When I found him endeavouring to prove,—*That the Electric Fire is not produced from the Globe by Friction;—That it is contain'd in, and ground from the Air, (like Corn from the Hopper in a Mill;)*—*That it moves spirally round the Globe, or Tube;—That Bees-Wax and Silk are a Caput Mortuum;—That Electricity forms a Capsula covering the Electrified Body, and pervading every Part and Particle thereof;—That it constitutes a Vortex of a Whirl-Pool of Fire;—That Sounds are occasion'd by*

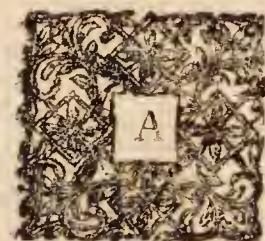
a Modification of Air;—That the Cracking of a Whip is caused by breaking the Continuity of the Air;—That the Electric Virtue darts with Repercussion; or infinite Recoil; &c. &c. &c. I say, upon reading a System of such Kind of Conjectures and Theses as these, I could not help having some Commotion and Commiseration for the Author; who seems to me to have no more Notion of the Nature and Cause of *Electricity*, than he has of the Elements of *Modern Philosophy*. It would be a great Wonder, indeed, if such wild Riveries, as are contain'd in that Book, *should escape the Censure of some who set up for Criticks*; but I think it will hardly be worth their while to try their Hands to condemn it; the Performance appearing too plain a *Felo de se*. Sir *Isaac* has too many Opponents, 'tis true; and I am sorry this Author should prove to be one of them; for I take it, that forsaking Sir *Isaac*, is as bad, if not worse, than opposing him; and I look upon Error in Philosophy to be hurtful. But Truth is still safe, and will be triumphant, (notwithstanding all the Cant of *Elementary Fire*;) according to *Esdras*,

Magna est Veritas, et prævalebit.





A N
E S S A Y
O N
ELECTRICITY, &c.



THE Power and various Phænomena of Electricity, which of late have been invented and exhibited in Experiments, have greatly amused Mankind, and justly raised their Wonder and Surprise, it is but natural to expect they should appear very anxious about the Causes thereof, or Manner of accounting for it; and also extremely inquisitive concerning the Uses that may be made of such an amazing Efficacy.

As to the First of these Particulars, viz.
The Cause of Electricity, and the Manner of
 B *account-*

accounting for its Effects, there have been many Hypothesis form'd to solve them ; but they have been chiefly invented by Men, who have appear'd to understand little or nothing of true Philosophy ; or else to have been so affected with Novelty and Singularity, that the Principles they advance are more doubtful and mysterious than the Causes and Properties of the Electric Virtue they account for by them. We hear People constantly debating on this Head, as if Sir *Isaac*, and his Philosophy, had never been heard of, or read.

FOR my own Part, I have been always persuaded we shall never arrive at the Cause of Electricity, unless we pursue our Enquires by the Clue given us by that Great Man. That is to say, the Nature, Cause, Properties, and Effects of Electric Virtue, are explicable only on the Principles of the *Newtonian Doctrine of Light and Fire*. This is therefore, in the first Place, to be premised, and which I shall lay down under the following Heads, *viz.*

First, WE find by Experience, that the Parts of all Bodies when agitated to a certain Degree, do so act upon Animal Bodies as to excite the Sensation of *Warmth* or *Heat*.

Secondly, SUCH an Agitation or intestine Commotion of the Parts of Bodies may be effected by various Means ; as Friction, Percussion,

cussion, Fermentation, Vital Motion, the Action of Light, &c.

Thirdly, THE *Standard Degree of Warmth or Heat*, is that of an Animal Body ; or in other Words, if the Parts of any Body have a greater Motion than the Parts of the animated Body, as the Hand, we say it is *warm* or *hot* ; but if they have less Motion than those of the Hand, we say they are *cold*. Lastly, if the Motion of the Parts are the same in both, we then say, such a Body is neither hot or cold. And hence it appears, that the Ideas of Heat and Cold are only in a comparative Degree.

Fourthly, THE Parts of Bodies when agitated, or heated beyond a certain Degree, emit or throw off such fine subtle Particles, or *Effluvia*, which *shine* or excite the Idea of *Light* ; and which therefore we generally call *Particles of Light*.

Fifthly, WHEN the Parts of the Body are so violently agitated, that they not only throw off lucid Particles, but also shine themselves, then we say, it is a *Body of Fire*, when the Particles are not in a *fuming State* ; but when they are, we call that lucid Fume a *Flame* of Fire.

Sixthly, THE Intensity of the Action of ignited Bodies depends as well on the Density, as the Velocity, of the Parts ; and when both these are in an extreme Degree, the *Momentum*, or

whole Force of the Heat becomes intolerable, and inconsistent with the State of a natural Body; and its Action is, in this Case, what we call *Burning*.

Seventhly, THERE are some Cases where the Parts may have sufficient Velocity to appear *lucid*, but not be dense enough, at the same Time, to *burn*.

Eighthly, THE Motion with which the Parts of Bodies are thus agitated to emit Light, and Heat, is of the vibrating Kind; because the Motions and Directions of the Particles in this Case may become uniform, consonant, and harmonious; and all conspire to produce the Effects which they could not do by a confused contrary Motion of Parts.

ON these Principles Sir *Isaac Newton* accounts very clearly for many of the wonderful Phænomena of Nature, especially of the *Phosphoreal* and *Electrical Kinds*. For Instance; the Shining of Sea-Water in a raging Storm; of Quick-Silver agitated in Vacuo; of Wood, Flesh, and Fish, by Putrefaction; the *Ignes Fatui*; of Stacks of Corn, Hay, &c. by Fermentation, growing wet, and firing; the Glowing of some Worms, Insects, and Eyes of Animals, by vital Motions; of *Phosphorus*, by Attrition, or the Action of the acid Particles of Air; of Iron hammer'd very nimbly, 'till it becomes red-hot; of the melted Parts of Steel struck off by
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a Flint; of Axle-Trees fired by the rapid Rotation of the Wheels; and of the Mixture of some Sorts of Fluids, producing great Heat, Accension, and Explosion.

BUT most expressly and largely, he applies this Theory to a General Explication of the Production of Electricity. He tells us, the Glass Globe, by Attrition with the Hand, will shine, and emit such an Electric Vapour, as by striking against Paper, Cloth, or the Finger, will be put into such an Agitation as to emit Light, and make the Paper, &c. appear lucid, like a Glow-Worm; and in rushing out of the Glass, it will sometimes push against the Finger, so as to be felt. Thus far Sir *Isaac*.

THE above *Theory of Light and Fire* will, I think, be nearly sufficient to solve all the Phænomena of Electricity; which I shall enumerate in Order as follows.

Phænomena I. THE *Electric Virtue* consists in a fine subtile Matter, ~~E~~mitted from some Sorts of Bodies under the Circumstances of Attrition, which Bodies are call'd ELECTRICS *per se*.

Phænom. II. THIS Virtue will not be excited in some Sorts of Bodies, which therefore are call'd NON-ELECTRICS.

Phænom. III. THIS Virtue repels all Light Bodies lying on the Surface of that in which
it

it is excited, which is term'd the *Electrized Body*.

Phænom. IV. THIS Virtue attracts all Sorts of light Substances within the Space of its Action, and then repels them again from the Electrized Body.

Phænom. V. IT suffers not the Body once repell'd to approach the electrized Body, 'till it has first touch'd some other Body; and then it will again attract it.

Phænom. VI. THIS Virtue will run off upon, or be received by all Non-electric Bodies; but will be refused or restrain'd by all Electrics *per se*.

Phænom. VII. THIS Virtue, when excited to a sufficient Degree, appears *lucid*, and shines in the Dark like a Flame.

Phænom. VIII. IT is emitted with great Velocity, attended with a *Snapping*; or small, but fierce Explosion.

Phænom. IX. THE Eruption of Electric Fire to a Non-electric Body, condenses the said Fire; and as this Fire is in a less or greater Degree, it appears of a bluish Purple, Yellow, or White Colour.

Phænom. X. IT runs thro' any Length of a Non-electric Body almost instantaneously.

Phænom.

Phænom. XI. IT kindles any inflammable Vapours or Fume, and thereby set the Body on Fire that emits it.

Phænom. XII. ALL the Properties and Effects of the Electric Virtue appear to be nearly the same, at any Distance from the Body in which it was first excited, and having pass'd thro' any Number of intermediate Non-electric Bodies.

THESE are the Principal Phænomena of Electricity, which we now proceed to give some Account of from the Principles of the above-mention'd Theory. As to the First, there can be no Doubt of the Existence of such a subtle Matter in the Substance of Bodies, or of its Emission or *Effluvium*, because it can be so easily demonstrat'd to the Senses by Experiments.

THIS subtle Matter, or Spirit, appears to be of an Elastic Nature, and acts by the Reciprocations of its Tremours, or Pulses, which are occasion'd by the vibrating Motion of the Parts of an Electric Body, excited by Friction. Hence as *Friction* is necessary to excite a vibrating Motion in the Parts of Bodies, in order to throw off the Electric Matter; it follows, that those Bodies, whose Parts, by Friction, will not conceive a Vibration, or be put into a uniform reciprocating Motion, will not prove Electrical, or be productive of Electricity: And the Defect seems to arise from the Want of a natural Elasticity of
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the Particles of the Body. Thus the White of an Egg in its natural State, or boil'd to a greater Consistence, is a Non-Electric; but when it is thorough dry and hard, it is then as Brittle and Yellow, and as Electrical as Amber itself.

NOR is it any Thing less than the highest Degree of Elasticity in Bodies that renders them capable of those Vibrations which put the Electric Matter into Action. For we observe the White of an Egg boil'd, and the strongest Glues, when cold, are considerably elastic, yet are utterly Non-electrical; even temper'd Steel itself, tho' so greatly elastic, shews no Signs of Electricity. In short, nothing less than that Degree of *Elaterium*, which makes Bodies brittle, and break with a Polish, as in Glass, Amber, Rosin, Pitch, Wax, &c. will constitute them Electrical.

THE Electric Matter, as it is emitted from the Body, enters into, and possesses every light Non-electric Body it meets with in its Way, and carries it by Impulse in its Direction, *viz.* from the Electric Body, this we call the *repulsive Power* of Electricity. This Electric Spirit having impregnated the light Body, and wholly possess'd it, begins there to form a new Sphere of Action, or Vibration; whose Pulses being in a contrary Direction to those of the Electrical Body, will cause the said light Body to keep every where beyond the Sphere of its Activity,

or

or to be constantly repel'd by it. This is very evident by Experiment.

HENCE it is, that when two or more Bodies are possess'd of the same Power, at the same Time, they always repel each other; so the *Plumulæ* of Feathers, while the Electric Virtue is among them, repel each other. Thus it is also in *Magnetics*; two Needles touch'd on the same Pole of a Load-Stone, repel each other, if put together by their touch'd Ends on the Surface of Water, or suspended on the Points of Needles.

HENCE also it is, that the Electrical Virtue will not run off the electrified Body to another which is an Electric *per se*; for tho' an Electric Body, in order to emit this Virtue very copiously, must be excited by Friction; yet we are to understand, that all Electrics *per se* have naturally a vibrating Motion of the Parts, by which they emit this Virtue in a less Degree, and imperceptably; and so have each a proper Sphere of Action; and the Pulses of each Sphere being in contrary Directions, cannot conspire and unite, but must restrain and cohibit each other. Thus the Flame at the End of the Iron, at the Approach of a *Match*, retires, and seems repel'd by the contrary Action of the *Brimstone*, while it is greatly dilated at the distant Approach of the Finger, and rushes against it with a Blast. Thus also is in *Magnetics per se*; for two

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Loadstones placed on the Water in Basons, or suspended by Strings, with their two similar Poles together, will always repel each other. Therefore it is, that when we would conduct or communicate the Electric Virtue to any great Distance by the Mediation of any Non-electric Body ; the said Body is either suspended by *Silken* Strings, which are electrical, or laid on *Cakes of Rosin*, that the Virtue might not run off thereby.

THE Electric Virtue in that Part of its Vibration, by which it returns to the excited Body in each Pulse, meeting with light Bodies in its Ways, impels them forcibly towards the Electric Body, and makes them appear to be attracted by that Body ; and so this is call'd the *attractive Power of Electricity*. But here it may be remarked, that Electric Bodies, if Light, as well as others, are attracted ; true, they are, but then they are not excited, and their natural Vibration, or Action, being very weak, will be overcome by the Power of the excited and stronger Electricity, and so carried or moved in its Direction. It may likewise be farther objected against, what I advanced above, that the natural Efficacy of the Silken Strings should be too weak to restrain the excited Electricity from entering its Substance, and running off by it ; but to this I answer, in the Silk there is naturally a Sphere of Action or Vibration ; in the Electricity of the electrified Body there is none,
'till

*till it begins to be emitted from the Extremity, or some other Part ; all the Motion that it has in the electrified Body being that which it first received from the excited Body, and is continued and propagated in the electrified Body by the natural Vibration of its Parts, which is weaker than that in the Silk, and therefore it must pass on by it, to make its Exit at the End.

As to the *Lucidity* of the Electric *Effluvia*, nothing more is requisite thereto, but a certain Degree of Velocity, which is easily produced by Attrition, according to Article 4th of the Theory.

IN order to account for the Snapping or Explosion of the Eruption of the electric Fire, it is to be observed, that this Explosion, like all others, consists in a violent Concussion of the Air, by a sudden Expansion and Bursting of the dense Stream or *Profluvium* of the Fire, in striking against the Non-electric Body. Yea, sometimes it will snap against, or in the Air only, as when it rushes out of the Mercurial Phial thro' the Pores of Sealing Wax. Now this Explosion must arise from that violent Action among the Electric Particles which proceeds from the extreme Degree of Velocity that constituted a dense Body of liquid Fire, (for it never snaps but in such a Case) and by that Action, as it becomes more dense, it becomes elastic ; and at length, by dashing against the

Surface of any Body, it is more and more condensed, and the innate Elasticity so far increased, as to cause it to burst, explode, or flash away in an invisible Vapour. And perhaps, this more adequately than Gun-powder itself, represents to us the true Cause of Lightning and Thunder; nor can we here suppose the Effects of Sulphur excluded; for as most metallic Substances, so Iron in particular, contains a great Admixture of Sulphur; now some of those sulphureous Particles, may, by the intense Action of the Electric Fire, be dissolved and carried with it into the Air, where the Nitro-acid Particles may conduce to the Accension, and promote the Explosion we are speaking of. And hence it may be, that the Communication, Action, and Explosion from Iron Substances are much more considerable than can be produced from any other.

WHERE the Electric Fire is not so much condensed as to snap, or explode, it goes off in a large dilated Stream of Purple Flame, and greatly resembles the Corruscations of the *Aurora Borealis*, especially that Part of the *Aurora* which appears in a constant streaming Light.

WHEN the Electric Fire is but a little dense, it appears of a bluish Colour, as all other faint Lights do; thus the Moon-Light, which is extremely weak, appears blue in Candle-Light:
And

And when the said Fire is a little more dense, it appears of a purple Hue, and has a greater Effect; a still greater Density makes it look Yellow, like Candle-Light; but the greatest Density is shewn by a yellowish White, like the Sun's Light, and then it produces the greatest Force of Explosion and Percussion. As yellow Lightning vanishes in an innocent Flash; but white and dense Lightning produces terrible Effects. So also *Phosphorus*, while agitated by a gentle Friction, spends itself in a lambent innoxious blue Flame; but when its Action is highten'd by a greater Attrition or Contusion, it kindles into a white Flame, and burns with an outrageous and unquenchable Fire. Therefore the Phænomena and Effects of Electricity, Lightning, and *Phosphorus*, seem to be of an homologous Nature, and to have something that is essential and common to each.

THAT the Electric Fire shou'd shew itself, and produce its Effects at any indefinite Distance from the excited Body, is nothing strange or unaccountable, when we consider it as a propagated Fire, and of a similar Nature to Lightning; for Fire of this Sort loses nothing, but rather is increased by its Propagation, with Respect to its Efficacy. As Lightning pervades soft and yielding Substance unhurt, and proves the Dissolution only of hard and compact Bodies; so Electricity is not felt in the soft and muscular Part of the Body, but strikes the
harder

harder Bones with a benumbing Shock. And as those denser Parts of Lightning which we call Thunder-Bolts, strike against hard Bodies, and glance by Reflection to different Parts; so the Fire of Electricity striking against the lower Part of the *Humerus*, at the Elbow of one Arm, seems reflected from thence across the Breast to the Elbow of the other Arm, and from thence flies out of the Body, if nothing be near it; but if several join Hands, it is almost instantaneously reflected from one to the other, though the Arms and Elbows of the whole Company, be they ever so many. Lastly, as Lightning does instantly deprive an Animal of Life, by its deleterious Stroke, when sufficiently dense; so the Electric Emanation may be so condensed, and its Force so encreased, as to strike a Bird quite senseless, and sometimes quite dead, in a Moment. The Parallel might be carried yet further, between Lightning and Electric Fire; but I have not Room to enlarge.

Thus I have proposed what I have to say, for a Solution of the several *Phænomena* of Electricity; for the most Part of which I have the Authority of an excellent Theory, and the Suffrage of a great many explicit and demonstrative Experiments, which I have subjoin'd for further Satisfaction and Entertainment of the Reader. These Experiments are such as I daily shew in my Course of Philosophy, and are there-

therefore indisputable Facts, and Topics of Argumentation.

BUT, now I am reduced to the arduous Task of answering this very common and important Question; “ *What is the Use of this most wonderful and surprizing Property of Bodies?*” Not but that my Answer is very short; and if it were to be but once or twice repeated, would be very easy, *viz. That at present I know so little of its Use, as not to be able to form any rational Conjecture about it.* What we know of this Kind must be discover’d by Experience. And as I am fully perswaded all the Powers of Natural Bodies were design’d to answer very great Purposes, yet what they are, are not discover’d to us all at once, but by slow Degrees. True Philosophy was but dawning fifty Years ago; and can we think it strange that any Thing should yet appear abstruse or difficult to account for? I rather wonder we have been able, in so short a Time, to discover so much relating to the Uses that may be made of it. As for Instance, the Analogy between the Fire of Electricity and Lightning; between its Snapping and Thunder; between their Forces and Effects on Animal Bodies, and Animal Life; between Electricity and common Fire, in respect of Velocity and Combustion; between Electricity and Phosphorous, in Regard of its various Degrees of Light, Colour of Light, and Manner of Burning. Moreover,
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we know it has a considerable Influence on Fluid Substances : A glaring Instance is that of the Syphon, and Sponge ; by which it appears, that Fluids in Motion, have their Motion greatly accelerated by the Electric Virtue. Thus if a Vein be open'd in a Person electrified, the effluent Blood will project to a much greater Distance, than it would otherwise do : And is not this a promising Indication of some great Use that may be one Time or other derived to the Animal OEconomy from Electricity?

YEA, further, I know from my own Experience, that different Persons are affected by the Electric Virtue in a very different Manner ; some prove extremely electrical, others very little susceptible of it ; and it has been found that a Person possess'd with the Infection of the *Small-Pox*, could by no Means be electrized at all. These are early and interesting Discoveries, and plainly intimate this wonderous Efficacy was intended for something more than meer Amusement to Mankind. What Relation it has to the *Animal Spirits*, or that which we mean by that Term, in *Animal Bodies*, I know not, but must leave to older and wiser Heads to determine by a longer Course of Experiments. What I have said, I submit to the Judgment of those whose Province it is to apply the Discoveries of Natural Philosophy, to the Utility and Benefit of Mankind. My Business is chiefly to make the Experiments, which I shall now
proceed

proceed to describe in all their proper Circumstances, as they are perform'd on a Machine, consisting of a large Wheel and Glass Globe, or Spheroid; fix'd in a large long Frame of Wood, made in most Respects like that of Mr. *Monnier*; but more easy in Operation, by Means of *Friction Wheels* on which the Axle of the great Wheel turns; the Rest of the Apparatus will be mention'd in the Sequel of the following EXPERIMENTS.

EXPERIMENT I.

ON the Axis, in the Center of the Globe, is fix'd a circular String of Threads, at small Distances from each other; and when the Globe is at rest they all hang down by their Gravity; but when the Globe is put in Motion, and a little heated, they all extend themselves from the Center to the Circumference, or inner Surface of the Globe, which they very nearly touch, in right-lined Directions, so as nearly to represent the Spokes of a Coach-Wheel. This they do by the Electric Virtue acting strongly upon them from the inner Surface of the Globe. And in this Condition they will continue, 'till the Virtue ceases, and the Globe becomes

D cold

cold, when they gradually fall down, and take the first perpendicular Directions.

EXP. II.

THE Globe being whirled round, and the Threads expanded as before, if the Hand or any Non-electric Body be moved towards the Surface of the Globe, the Threads within will seem immediately sensible thereof; and, as if animated thereby, will, in a very wonderful Manner, move every Way to the Hand, by a Motion like that we observe in the Legs of a Spider, especially that Sort we call a *Carter*, or *Father Long-Legs*. By this Experiment we observe the surprizing Nature and Subtilty of this Kind of *Effluvia*, as it is seen to penetrate and pervade the Substance of Glafs with the same Readiness and Freedom as if nothing were in the Way to intercept it.

EXP. III.

A Hoop of fine Threads being placed any how about the Globe in Motion, will have all the Threads drawn out of their natural perpendicular Directions into others which pass thro' the Center of the Globe, and so will be all perpendicular to the Surface, which makes a very pleasing Spectacle. By this Experiment it appears, that the Electric Virtue acts equally both within-side and without the Globe, and in Directions perpendicular to its Surface.

Hence

Hence also we see the Power of Electricity is greater by far than Gravity with us.

EXP. IV.

THE Hoop of Threads remaining about the Globe in Motion, as in the last Experiment, if the Room be darken'd, the Ends of the Threads on the Outside of the Globe will be all tip'd with Fire, and make a beautiful Apparition of Stars : Which shews, that the *Electric Virtue* is a fine thin bluish Flame of Fire, much like that of Phosphorus gently rubb'd in the Dark. The Threads within exhibit no Appearance of Light ; which shews, that this Virtue acts only outwardly, and by that Means the Threads within are drawn towards the Surface.

EXP. V.

A long, pointed, Piece of Iron being laid on a Frame of Silken Strings, with one End about a Quarter of an Inch from the Globe, will, at the other End, (which terminates in a conical Point) emit a Purple Flame of electrical Fire, diverging each Way from the Point, like the Rays of the Sun from the Focus of a Burning Glass in a darken'd Room. This Pencil of electric Rays is visible even in the Day-Light, but is extremely so in the Room made dark ; and if the Finger be held within

a Quarter of an Inch, it causes the Fire to issue out in a greater Quantity, and to appear much more luminous than before.

EXP. VI.

THE Finger being placed as above directed, within a Quarter of an Inch of the said Flame, will be sensible of a gentle Blast of Wind from the End of the Iron, that is, the Electrical Fire will issue out of the Point in such a Manner, as to blow against the Finger very sensibly; and if the Finger be held still nearer, the large Pencil of Rays will be condensed in such a Manner as to run out of the Point upon the Finger in a Stream, or Body, of dense yellow Fire, and strike the Finger like a gentle *Jet d'eau*; and indeed the Phenomenon may be truly call'd a *Jet de Feu*. This Electric Flame also is sensible to the Smell, and much resembles, in that Respect, the Fire of *Phosphorus*.

EXP. VII.

IF, while the Flame continues to appear from the Point of the Iron, the Finger be placed any where upon the Iron, the Flame at the End disappears immediately; if the Finger be taken off, it again does instantly appear; and so by putting the Finger off and on successively, the electric Flame will appear and disappear alternately. The Reason whereof is, that when the Finger is applied, the Electric
Virtue

Virtue all runs off upon the Finger, as a Non-electric Body, and therefore cannot go to the pointed End to produce the Flame, as it does when the Finger is taken off.

EXP. VIII.

IF a Musket-Barrel be suspended, and the Finger applied near it, (as within $\frac{1}{5}$ of an Inch) the Fire will forcibly issue out, and strike it, and in striking it will give a very sensible Snap; and several Fingers being successively applied to the Barrel, will cause several such Erruptions and Snappings of the Fire, which will be all very sensible to the *Feeling*, to the *Eye*, and to the *Ear*; and produce a most extraordinary and entertaining Phænomenon.

EXP. IX.

IF a *Chain*, or *Hempen-Cord*, be suspended by Silken Strings, all round the Room, of any Length you please, and one End thereof be hung by a Loop across the Barrel, the Electrical Fire will instantly be transmitted thro' the whole Length of the Chain, and appear upon every Part at the Approach of the Finger, and be heard to snap, and strike with as great, if not greater, Force, than from the Gun-Barrel itself. In this Particular, the Electric Fire seems somewhat a-kin to that of *Lightning*.

EXP.

EXP. X.

IF a Feather be suspended by an Hempen or Flaxen Thread, or String, it will, when held near the Barrel, be strongly attracted thereby, and adhere immoveably thereto; because all the Electricity goes away, or runs off thro' the Non-electric Bodies, with which the said Feather communicates. But the Manner how the Feather can be attracted by a Virtue or Power acting outwardly, and in contrary Directions may seem somewhat strange, yet is accounted for by the foregoing Theory.

EXP. XI.

THE same Feather, or any Light Body, suspended near the Gun-Barrel by Silken String, will be first attracted by it, and then soon afterwards repell'd; and will continue to be so repell'd 'till it has touch'd some other Body. The Reason of this is, that upon the Contract with the Barrel, the Feather is impregnated with the Electric Virtue, which will not run off upon the Silken String, as being an Electric per se. Now it is found to be the Case of all attracting Powers, that Bodies equally possess'd with them always repel each other, unless they are either in immediate Contact, or very near it. But when the Feather has touch'd some Non-electric Body, it loses its Electricity, and again becomes capable of being attracted.

EXP.

EXP. XII.

IF the Silken String by which the Feather is suspended be wetted throughout its Length, it will become a Non-electric Body ; and the Feather, instead of being attracted and repell'd, will now be only attracted. For all the Electric Virtue runs off by the Moisture of the Thread : By which it appears, that Water, or any Kind of Moisture, is a Non-electric Substance, and so a Conductor of Electricity. Hence it is, that in a moist Air, the Feather in its repell'd State will, by Degrees, loose all its Electricity among the aqueous Particles, and will then again return to the electrized Barrel, by Attraction.

EXP. XIII.

IN like Manner, a Card, or Tin-Plate, being fitted into the End of the Barrel, if any light Bodies be laid thereon, (as Leaf-Gold, Silver, or Brass, &c.) they are immediately repell'd, as if blown away with a Blast of Wind ; nor will they come near the Barrel, or Plate, again, 'till they have first discharg'd their Electricity on some Non-electric Bodies.—*Note*, While the Globe is whirling round, some Person standing by must lay his Finger over the Barrel, to prevent the Electric Virtue going to the light Bodies, 'till the appointed Moment ; when, upon taking off the Finger, they all fly off at once,

EXP.

EXP. XIV.

IF under the said Plate you hold another, with the same light Bodies upon it, they will be attracted and repell'd alternately between the two Plates, in a very entertaining Manner, and with a very great Velocity; and for a considerable Time. The Reason why they are attracted a Second, Third, &c. Time, is because each Time they are repell'd back to the lower Plate, they loose upon it all their Virtue, and so become again attractible.

EXP. XV.

IF a large plummy Feather be suspended horizontally at the End of a long Chain, communicating with the Barrel, and another set upright under it, on a Cork, in a Glass Phial upon a Pedestal; then when the Finger (before laid on) is taken off the Barrel, 'tis very pleasant to see how the Electricity coming among the *Plumulæ*, or Fibres of the suspended Feather, will cause them to extend and expand themselves every Way from the Rib of the Feather, at the same Time they will attract the Feather beneath, and cause its Fibres to raise themselves, and bristle out in the same Manner. Here 'tis observeable, that all the *Plumulæ* repel each other, and therefore stand at an equal Distance nearly; and this they do, as being all possess'd of the same Virtue, which cannot

cannot go off, because of the Glass Phial, which is an Electric *per se*.

EXP. XVI.

WHILE the Feathers are in their repellent State, if any one lays his Finger on the Barrel, or any Part of the Chain, it is beautiful to see how instantly the Feathers are sensible of it, by letting their Plumage all fall and drop into their natural State. As also if he but slightly touches the Barrel, or Chain, the Feathers suddenly catch, and shrink in, like the *Sensitive Plant*; and hence, by the Way, some think the Phenomena of that Plant are owing to the repulsive Power of Electricity between the Finger and its Leaves.

EXP. XVII.

IF while the Feathers are electrized a Person approaches his Finger near them, (especially that which is suspended) they will immediately point all their *Plumulae* towards the Finger, and be strongly attracted by it; and if the Finger touches the Feathers, they all seem eager to embrace it, and are strongly attached thereto; if the Hand be moved round about the suspended Feather, the Feather will nimbly turn after it, and every where endeavour to lay hold on it; which, when it does, it looses all its Electricity, and again becomes Non-electric.

EXP. XVIII.

IF to a Gun-Barrel you adapt a small Tin Cup, and pour in Water ; then a Person holding his Finger perpendicular over the Water, and within a Quarter of an Inch of its Surface, or less, will find the Water rise up in Form of a Cone to meet his Finger, and from the Vertex or Top thereof, a little Stream of Fire will issue to the Finger, and snap against as usual, tho' not with so much Force as from the Sides of the Pot or the Barrel itself. It is observeable, that neither the Water nor any other Body will be in the least sensibly heated by all the Electric Fire they are capable of receiving. Whence it appears, that this Fire is not sufficient to put the small Particles of Bodies into such a Vibration or Agitation, as to excite the least Sensation of Warmth or Heat.

EXP. XIX.

IF a Sponge, thorough dry, be hung on to the electrified Barrel, it gives no Appearance of Fire, which shews it to be an Electric Substance : But if when the Sponge has been immersed in Water, it be suspended to the Barrel as before, and the Finger or Hand be applied near to it, the Fire issues out with considerable Force and Snapping, and the Drops which before the Sponge was electrified fall very slowly, will now fall very fast ; if the Room be darken'd, these
Drops

Drops will appear to be *Drops of Fire*, and illuminate the Bason into which they fall.

EXP. XX.

IF a Capillary Syphon be hung on to the small Cup of Water above-mentioned, at the End of the Barrel, and the Finger laid across the Barrel to prevent the Electric Virtue going to the Water; then before the Water is electrized, you observe the Syphon to drop only, and that very gently; but when the Finger is taken off, and the Water becomes electrized, the Syphon runs a Stream; and if the Room be dark, it issues from the Syphon in the Appearance of Fire.

EXP. XXI.

his A Person standing on a Cake of Rosin, with Hand laid on the Gun-Barrel, if a Vein be open'd in his Arm, then (if the Electricity be stop'd by the Finger, as above) the Blood will fly out to a certain Distance; but when the Finger is taken off, and the Person by that Means electrified, the Blood will receive an *Impetus* thereform, and spin out with a much greater Velocity, and to a much greater Distance than before.

EXP. XXII.

IF a Phial of Water be provided, and well cork'd, and a Wire bended on the Top be pierced thro' the Cork, and thrust down near

the Bottom of the Phial, leaving the upper Part standing about two or three Inches above the Bottle, then laying this Wire on the Globe in Motion, the Wire will receive the Electricity from the Globe, and the Water will be impregnated therewith, the more as the Wire is kept longer on the Globe; then the Person thus holding the Phial in one Hand, is to approach a Finger of his other Hand near the middle Part of the Globe, and he will receive the Electric Eruption of Fire with a very considerable Snap and Force, greater by much than what proceeds from the Barrel alone; the Reason is because all the Electricity running thro' the Wire into the Water, is there condensed as it were, and confined by the Electric Substance of Glass, and so acts in a greater Quantity, and therefore with a greater Force, than when it issues from the Barrel unconfined.

EXP. XXIII.

IN Order to make this Condensation of the Electric Fire yet greater, the Cork and Top of the Phial is to be closed every Way very nicely with Sealing-Wax; and then applied to the Globe, as before, when the Phial of Water has been fully saturated with Electricity, the Surplus will immediately issue out in wonderful Streams of Purple Fire, thro' several Pores it finds in the Cork and Wax; and very often in many of these Streams which make a beautiful

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Appearance in the Room when darken'd, and is a most singular Phænomenon in Nature.

EXP. XXIV.

IF instead of Water we fill the Phial with Quicksilver, the Snap and Force will be somewhat greater, but nothing near in Proportion as Mercury is denser than Water; so that the Force of Electric Percussion does not appear to depend upon the Quantity of Matter in the percussive Phial, for if it did, the Phial of Mercury must give fourteen Times a greater Stroke (*cæteris paribus*) than the same sized Phial of Water, which it does not do, and therefore some other Principle of Action seems latent in the Substance of Bodies.

EXP. XXV.

WHILE the Phial of Mercury is electrizing on the Globe, the Electric Streams will issue out of the Sealing-Wax more copiously than from the Phial of Water, and will of themselves snap; and these Flashings and Snappings succeed each other sometimes very fast, and represent, as it it were in Miniature, an *artificial Thundering and Lightning*; and their Phænomenon is peculiar to the *Mercurial Phial*, the Phial of Water never snapping of itself that I have yet observed.

EXP.

EXP. XXVI.

IF either the Phial of Water or Mercury, when electrized on the Globe, be hung on the Gun-Barrel, the Hand still holding it fast, then a Finger of the other Hand applied near the Barrel, will draw off a Spark that will give a very sensible Snap and Stroke, which will be felt in one or both the Arms, and also across the Breast; and it is very remarkable, that this Sensation is rather an *uneasy* than a *painful* one, and goes no farther than the Elbows, in general.

EXP. XXVII.

IF the Electrical Virtue be sufficiently condensed in the Phial, by holding the Wire long on the Globe, then the Room being made dark, and the Phial held up with the Hand, the Electric Fire will be seen to go off from the Point of the Wire in a small white Flame, which will continue some Time; and if a Finger be applied near it, the Wire will emit it with a Snap, but not so forcibly as when held on the Globe. And this is the only Way, perhaps, of retaining the Electric Fire, or making its Action temporary. And the Letter from *Paris* says, it has been thus retained in the Frost for 36 Hours together. But I cannot produce any Permanentcy of its Efficacy like that.

EXP.

EXP. *XXVIII.*

A Person standing on a large Cake of Rosin, at least three Inches thick, laying one Hand on the Gun-Barrel, will be electrized, that is, he will be all over possessed with the Electric Virtue, and at the same Time feel nothing of it, unless some Person standing by put his Finger near to any Part, and then the Virtue will be emitted in Form of Fire from any Part, and snap, and become very sensible to both the Parties, but in a very innocent Manner.

EXP. *XXIX.*

IF the Person electrized holds in his Hand a Sword, or any pointed polish'd Piece of Iron, and the Room be darken'd, a continual Flame issues out of the Point every Way, like that described in Exp. V. and VI.

EXP. *XXX.*

IF the electrized Person hold a small Cup of Water in one Hand as he stands upon the Rosin, and with the other takes hold of the Wire in the electrified Phial, and then the Person who holds the Phial, by approaching his Finger near the Surface of the Water, will cause it to emit the Fire with a more sensible Snap and Force, than can be excited without it.

EXP.

EXP. XXXI.

IF the Person standing on the Rosin holds a Piece of Money between his Teeth; and the Wire of the electrified Phial with one Hand; then if the Person who holds the Phial touches the Money, the Shock will be very sensibly in the Teeth and Head of the electrified Person who holds it, and also to the other who touches it.

EXP. XXXII.

LET a Person stand on one Cake of Rosin, and lay one Hand on the Barrel; and let another Person stand on another Cake by him, and then when the first Person is thoroughly electrized, let them both incline their Heads and salute each other, and the Fire will join their Lips when nearly touching, and give them a smart and mutual Rebuff, which will make them separate more hastily than they joined: But yet the Pungency is not so great as to be very disagreeable.

EXP. XXXIII.

A Wire fixed on a Pedestal, and placed upright in a Bason of Water, is to be electrified from the Phial above-mentioned, and then the Person holding the Phial is to touch the Surface of the Water in the Bason with the other Hand; the Fire here has a considerable

able Effect, but not so great as the Letter from *Paris* seems to intimate, at least I could never find it so.

EXP. XXXIV.

THE Phial being electrified, as above, the whole Company join Hands, or communicate with each other by Wires; then the Operator, or Person who stands first, at one Extremity of the Line, hangs the Electrized Phial on the Barrel, when the Person at the other Extremity draws off the Spark from the Barrel; and at that Instant all the Company receive the Shock which they feel to their Elbows, and in both their Arms. But I could never yet find those Shocks so violent and dangerous as they have been represented, tho' they are nearly as great as any Person (especially the *Men*) care to endure. This Experiment will equally succeed, be the Company never so large.

EXP. XXXV.

A Person standing on Rosin, with one Hand on the Barrel, points the Finger of the other to the warm Spirits of Wine, and by communicating the Electric Fire thereto, kindles the rising Fume, and so sets the Whole on Fire. In this Manner, any Sort of Matter, which, when warm'd, will send forth an inflammable Vapour, may be thus set on Fire.

F.

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EXP. XXXVI.

ANOTHER Way to set Fire to the Spirit is this; the Person holds the Phial of Mercury, or Water, when electrified, on the Barrel with one Hand, and the warm Spirit being put into a Cup or Spoon adapted to the Barrel, and thereby strongly electrized, a Finger of the other Hand being held over and near the Spirit, draws the Electric Spark out of it, and with a Snap sets the Vapour in a Flame, and consequently all the Spirit.

EXP. XXXVII.

BECAUSE *Gunpowder*, when heated, emits no inflamable Stream, it cannot be fired by itself; but if you mix it with a little inflamable vegetable Oil of any Sort, and grind them a little together, and then put a little into a Spoon, and Heat it, the Vapour will be fired in each of the two Ways above-mention'd for firing the Spirit, and will set Fire to the Oil and Powder nearly at the same Time, and the Powder will be exploded in the same Manner as it usually is, when wetted. But it may be fired dry, by mixing it with *Camphor*, and reducing both to a Powder, for this will send forth an inflamable Vapour, which will be kindled when heated, in either of the Methods above described.

EXP.

EXP. XXXVIII.

IF a Plate of Tin be adapted to the End of the Barrel, and another be held about two Inches under it with a square or long Piece of Leaf Gold, Brass, &c. then while the Barrel is electrified the said Piece of Gold will be swiftly at first attracted and repelled between the two Plates, 'till at last the Action between each becoming equal, the Leaf Gold will be so equally affected by either, that all its variable Motion will be destroyed, and it will appear to be suspended at Rest between both, and afford a most surprizing and agreeable Spectacle.

EXP. XXXIX.

IF a small Bell of a Clock be fixed to the End of the Gun-Barrel, and another at four Inches Distance on a Pedestal of Wood at the same Height, and then a small Ivory Ball be suspended by Silken Strings in the Middle between both; the Barrel when electrified will electrize the first Bell, and that will attract the Ivory Ball; as it hangs by Silk, which is itself electrical, it will retain all the Electric Virtue it receives from the Bell, and therefore will be repell'd from it, and thus be made to strike against the other Bell; on this it will discharge all its Electricity by Contact, and so become again a *Non-Electric*, and in that Case will be again attracted by the first

first Bell. And this Effect will be produced alternately; so long as the Globe is in Motion; the Consequence of which is, that the Ivory Ball will be put into constant Vibration, and make an *Electrical Pendulum*, which, as it strikes each Bell, it make them ring, and produce one of the most agreeable Effects both to the Eye and Ear.

Exp. XL.

IF a small Plate be held under that adapted to the Gun-Barrel, and light Bodies laid upon it, and then a fine Piece of Muslin or Lawn be interposed between both; the electrized Barrel will not affect the light Bodies, but they will remain absolutely at rest. For the Electric Virtue will all run off upon the Muslin, and its Supporter, as being non-electric Bodies; and so will not come near the light Bodies to put them in Motion.

Exp. XLI.

IF a *Loadstone*, arm'd with Iron, be hung on to the Gun-Barrel by an Iron Wire, the Electric Virtue will rush out from every Part, but more forcibly from the Iron than from the Stone itself; from the Stone it seems to be emitted in a more lax Manner, and diffused in a Sort of Steam or Fiery Vapour; whereas from the Iron it issues in a more impetuous, dense, and penetrating Stream. By this Experiment we see the two most considerable Powers of Nature, *Electricity* and *Magnetism*, do no Ways interfere, or impede each other's Action.

Exp. XLII.

IF the Globe be exhausted of all its Air, and then whirl'd about on the Machine, the Electricity will be observed to act wholly within the Globe, where it will appear (in a darken'd Room) in Form of a Cloud or Flame of reddish or purple colour'd Light, filling the whole Capacity of the Globe. This voluble Flame will be diminish'd, and disappear by Degrees as the Air is gradually admitted into the Globe. The Reason why the Action of the Electric Virtue does not shew itself *outwardly*, is the strong repulsive Power of the electric Particles of Air encompassing the Globe, confining the Electric *Effluvium* and causing it to tend inwards, where it meets with no Resistance in the vacuous Sphere.

F I N I S.

